Gas Journal

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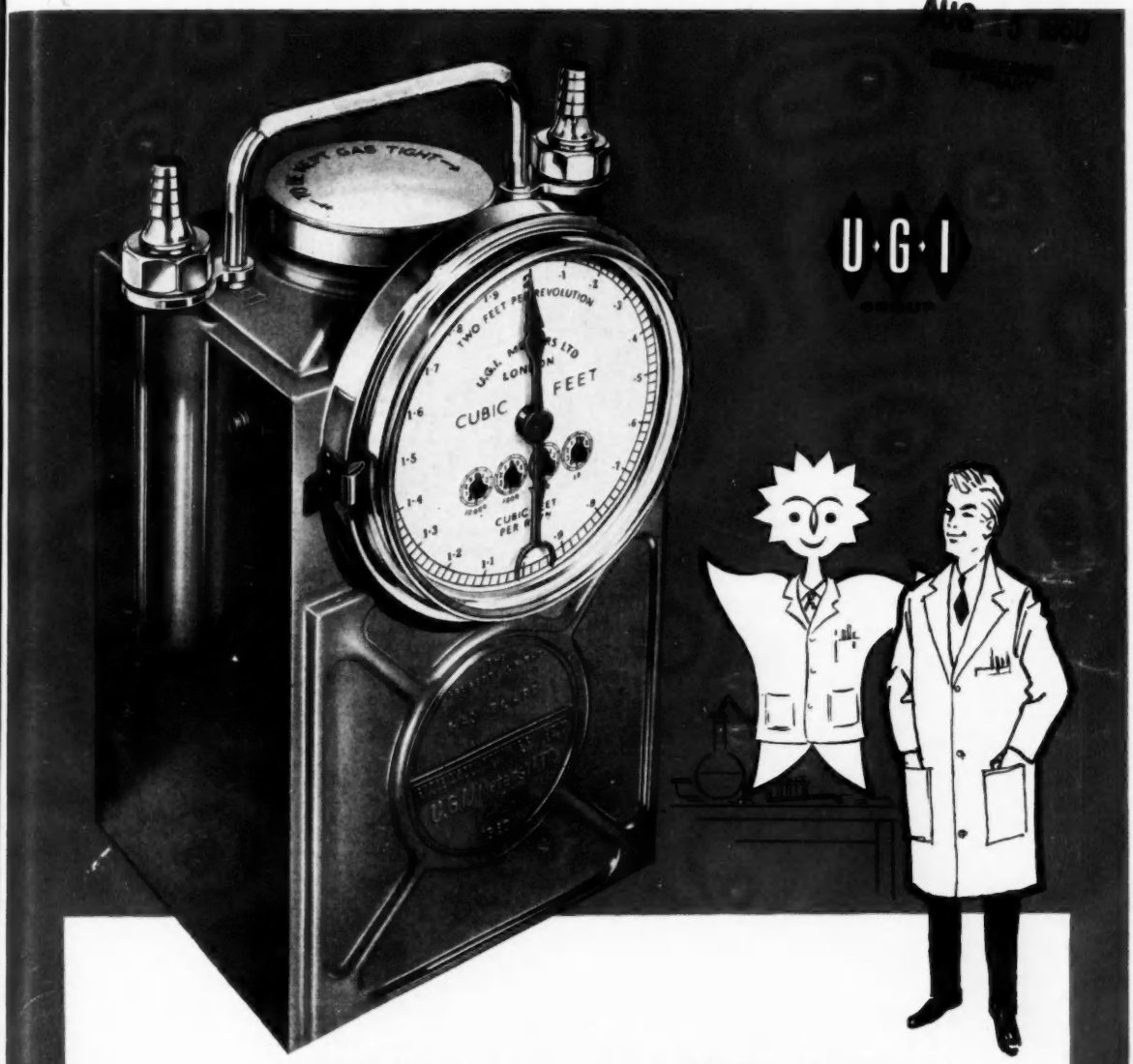

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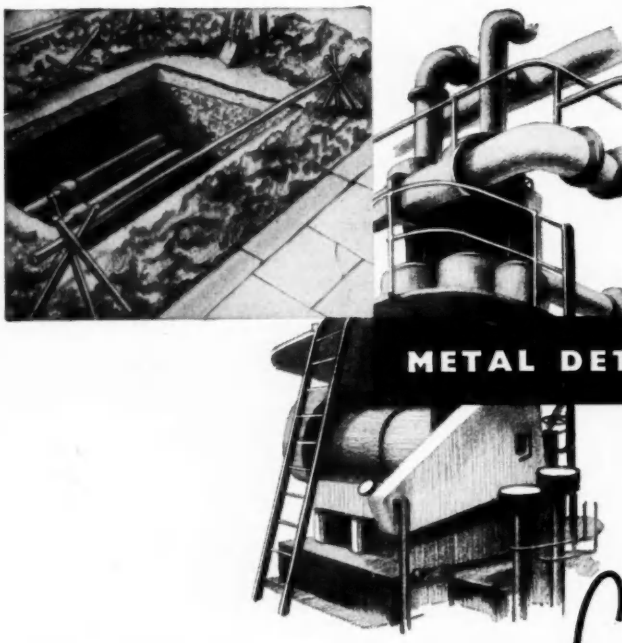

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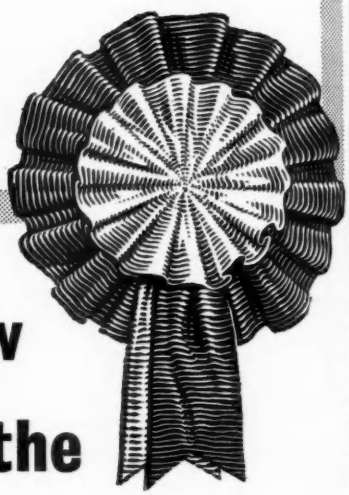

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A new approach to purification

GAS purification is a subject which continues to exercise the minds and ingenuity of gas engineers. The mechanism of the well-known oxide purifier seems to be slowly revealing itself, and every time another glimpse of the working of this seemingly complicated reaction is vouchsafed to the engineer, he is better able to guarantee clean gas and an economic working-up of spent oxide.

The paper we are publishing this week, 'Modern Trends in Gas Purification,' by Mr. J. J. Priestley and Mr. W. E. Bouch, both of W. C. Holmes & Co. Ltd., deals with the subject on a much wider front. In fact, purification in the narrow sense of extracting hydrogen sulphide from crude gas before its enters the works holders accounts for a comparatively small proportion of the paper, but the authors make two important points. The first is that the rapid rotation of oxide purifier boxes confers a considerable advantage on the operation of any such plant and allows its fully designed capacity to be attained with the economic working-up of the oxide.

Among gas engineers as a whole there seems to be some divergence of opinion as to how great this advantage really is, but those who accept it, accept it wholeheartedly. The authors quote a new installation at Southampton dealing with refinery gas containing up to 1,200 grains of hydrogen sulphide per 100 cu.ft. The rotation of the boxes is entirely automatic and can be made to take place every two hours. This plant has worked since last December without trouble.

The second point of interest made by the authors concerns liquid purification. They quote the 'Manchester' process as being easily capable of reducing the hydrogen sulphide content of crude gas to below the statutory requirements, but at a high operating cost. Added to this there is difficulty in disposing of the sulphur recovered. This latter point may be equally true of either liquid or solid processes, and is steadily becoming a serious factor in estimating the operating costs of any purification system. The very large quantities of high grade sulphur now being made available in South Western France are likely to aggravate the situation still further. Any doubts about the future of the oxide purification process which we may have had, may therefore be discounted. Rapid rotation and automation as well as modern methods of oxide handling have assured its continued use.

There is a passing reference made in the paper to the Gastechnik and the Appleby-Frodingham processes, both of which use oxide in modified forms. The first of these is becoming established in Great Britain and has the advantage of producing a fairly high grade sulphur as a residual product and comparatively small quantities of unusable oxide, as well as needing little labour to operate it. Of the latter, experience of its use in the gas industry is limited, but the fluid bed technique it employs, promises additional advantages in ease of handling and possibly of revivification.

The authors then pass to three other aspects of purification, the first of which, dehydration by freezing out the water vapour to a gas dew point of 37°F., is of importance in modern grid distribution systems in that it does away with the need for syphon pots, but it was something of a surprise to us to find it included under the title of this paper. The system described is of great interest and a big advance on the calcium chloride dehydration systems.

The remaining subjects dealt with are the catalytic conversion of organic sulphur compounds to hydrogen sulphide and the detoxification of town gas by converting the CO present to CO_2.

Both these aspects of purification, though by no means new are, we think, extremely topical. The lowering of the organic sulphur content of town gas is becoming increasing important for both industrial and domestic uses. The battle of the fuels might well turn on this very point in favour of manufactured gas as opposed to l.p.g. or oil. Industrial gas of constant combustion characteristics and of very low total sulphur content, by its availability and ease of handling and control could, we feel, hold its own. Domestically the flueless heater demands a sulphur-free gas for its full exploitation. The authors deal in some detail with the temperature conditions under which the Holmes-Maxted

catalytic process works, and stress advantages to be gained by operating it at the lower of the two alternative temperatures mentioned.

Successful though this particular plant is, as far as we know there is only one full scale plant now in use. The plant at Jersey appears to be reducing the organic sulphur content of a c.v.r. gas down to less than 5 grains per 100 cu.ft. with marked success. In spite of this, however, most other undertakings have concentrated on gas washing with additional quantities of oil. This has the disadvantage of extracting benzole at the same time. If therefore a gas of higher calorific value is needed, and the benzole is to be retained, the catalytic plant would clearly have a distinct advantage. It is understandable that where benzole extraction is already practiced, provision of additional oil circulation may well be all that will be needed to reduce organic sulphur to the desired limits.

The detoxification of town gas by reducing its carbon monoxide content from the maximum permitted proportion of some 20% to about 5% is advocated by the authors as being perfectly feasible. The importance of this appears to have been recognised on the Continent earlier than in this country, and we recall an announcement that a considerable reduction in the carbon monoxide content of the gas distributed in the city of Basle had been achieved. The process employed, the shift reaction by which the carbon monoxide in the presence of steam is converted into carbon dioxide and hydrogen, may cause a considerable change in the combustion characteristics of the gas as well as reducing its calorific value. If the carbon dioxide is extracted the specific gravity is likely to fall with the predominance of hydrogen.

The authors suggest cold enrichment with butane. This process has shown very distinct possibilities and when the final characteristics were compared with the original measurement according to the methods of Gilbert and Prigg, there was little change.

The detoxification of town gas is we feel an important step forward in rooting out a prejudice against the use of gas in the home. The authors point out that a considerable degree of detoxification is possible by slightly altering the conditions of catalytic organic sulphur removal. If these two processes can be combined and cold enrichment be practiced at a reasonable cost, a great step forward will have been taken in overcoming two of the objections now levelled against the use of gas.

World power and gas

THE sectional meeting of the World Power Conference in Madrid last month heard papers interesting to the gas industry from countries as far apart as Great Britain and Japan. The subjects discussed touched every aspect of fuel production, transportation and utilisation. Apart from those dealing purely with gas problems, the papers dealing with solid fuel are also of interest.

Mr. G. Armstrong, Chief Geologist to the National Coal Board, presented a paper on the exploration of British coal deposits. After outlining the geological conditions under which coalfields were laid down, he talked of the necessity for proper investigation of coalfield structure if pre-planning of colliery development were to be made possible. Such investigations were useful in forecasting the availability of certain types of coal and showing how modern extraction methods could be applied.

It has always been hoped that the transportation of water-suspended coal by pipeline would be a cheaper means of bringing coal from the colliery to the consumer. With the exception, however, of certain large-scale and only partially successful American experiments, little use seems to have been made of the method. A paper by M. P. Aubathier, Chief Engineer of the collieries in the Lorraine Basin, shows how slurries from five washeries were successfully taken to the Emile Huchet central power station. The output from three of the washeries was collected at a fourth, the Freyming, and transported by a 375-mm. pipeline a distance of 9.2 km. The output from the fifth washery was carried by a 113-mm. pipeline 1.7 km. long. The author also describes a system of raising coal of 0—50 mm. (about 2-in.) and 0—80-mm. (about 3¼-in.) a distance of some 80 m. to the Pigeon washery in the Loire Basin. These distances are short but the saving in handling costs appears to be large enough to justify the expense of the necessary auxillary plant.

A third paper on solid fuel dealt with the problems facing Charbonnage de France in supplying its diverse customers with the types and quantities of coal they need. The author, M J. Lepide, the firm's engineer, describes how the problems have been overcome by statistical methods using a punched card system. By continuously collecting information and incorporating it into the system each month, the central coal distribution department can be kept completely up to date about available stock and its customers' demands.

The papers on the transmission of natural gas included a description by Mr. L. J. Clarke, Assistant Chief Engineer of the North Thames Gas Board, of the work which culminated in the voyages of the Methane Pioneer. Mr. Clarke's paper gave the history of large-scale natural gas liquefication and referred to both American and British contributions. In the description of the vessel itself was information previously unpublished and for this reason alone, his paper was timely. Other papers on natural gas dealt with transmission and storage, except those on production at Lacq by MM. H. Rutman and M. Vicart, both of the S.N.P.A., and a discussion on the best use of natural gas deposits by M P. Victor and two of his colleagues from the Institute of Energy of the Rumanian Academy.

Of the four papers on transmission and storage, two were from the Western Hemisphere. Mr. R. B. Tombs of the Mineral Resources Division of the Department of Mines in Canada described the very extensive pipelines transporting oil and natural gas from the Prairie Pro-

vinces, British Columbia and the North West Territories to the coast and across the United States frontier. This paper reminds one again of the particular problem Canada has to face; the possession of very considerable mineral resources in a very large country with an indigent population, too small to fully justify their exploitation without a large volume of exports.

It was quite clear from this paper that an economic load factor on these very extensive pipelines would not have been forthcoming without the export of large quantities of gas to the northern United States and into the North West Pacific natural gas distribution system at Seattle. The building of the Trans-Canada pipeline 2,290 miles long with a total compressor capacity of 48,500 h.p. in six compressor stations, the longest pipeline in the world, has made it possible for natural gas to be brought to the most populous parts of the Dominion. From the ranching country the gas comes to the centres of population in Ontario and Quebec. Canada has become gas-minded and, as well as providing a better service to existing consumers, expects a great expansion in demand. In the five years 1959 to 1963, a sales rise of some 133% is forecast with a drop in transmission charges of about $1 per 1,000 cu.ft. per 100 miles.

Mr. K. B. Nagler, of the Peoples Gas Light & Coke Company, Chicago, in his paper on the transportation and storage of gaseous fuels referred to the enormous increase in gas demand during the last 30 years and how it had been made possible by the proving of a number of gas fields in the South and the South Western States. With this expansion has come the problem of the very heavy peak load demands.

This particular section of the conference showed that gas is becoming one of the world's major sources of energy. How to exploit the gas, manufactured or otherwise, to the full, and bring it to the consumer is a problem that the papers referred to are trying to solve.

Comments on the week's news

Ascot in Holland

IT is always interesting to learn something of the activities of British gas appliance makers abroad. No manufacturer in the field has achieved more in the export market than Ascot Gas Water Heaters Ltd., whose most recent conquests have been in Holland.

The marketing of water heaters on the continent is largely achieved through local plumbers who all possess showrooms, some very elaborate. They buy appliances through wholesalers who also sell competitive heaters. Junkers, Vaillant and Fasto, have been in the market for a number of years; the Fasto being of Dutch manufacture is given preferential treatment.

Under these conditions it was impossible for Ascot to compete from a distance and it was therefore decided to appoint their own resident representative in Holland to promote the sales of the new Type 512 sink heater. At the same time they set up an office, showroom and service facilities in Utrecht under the name of Ascot-Nederland at Kapelstraat 23 bis, Utrecht.

The next job was to interest a number of wholesalers. Mr. D. G. Goffin, Deputy Export Manager of Ascot, was sent to Holland in November last year to conduct a survey. In January, six wholesalers, Fa. M. van Alphen of Venlo, C. J. van den Broek of Haarlem, C. J. van den Broek of Amsterdam, Pot & van Nes of Rotterdam, Firma W. J. Dales of Doetinchem, and Firma Grosa of Tilburg, were formed into an 'Ascot Club.'

The plan of attack was to advertise in all appropriate trade magazines commencing with the January or February issues. The advertising was scheduled for 12 months featuring the full technical specification of the 512 and also listed the names of the wholesalers from which the plumbers could buy. After three months trade advertising a series of receptions were held, to which plumbers, architects and gas board personnel were invited. Mr. W. van Leeuwen, Ascot's Dutch representative, aided by coloured slides, opened the receptions with a short instructive talk, and a well-known Dutch Radio personality, Cees de Lange, was engaged, together with supporting artists, to provide entertainment. To coincide with the receptions, advertising in the consumer press commenced on April 2 in the household section of *Elseviers Weekly*, and point-of-sale material in the form of showcards were made available to the plumbers by the Dutch office.

Clearly the company is making a determined effort to establish these appliances in Holland, and it is pleasant to learn that orders are beginning to flow in. A pictorial feature on the campaign appears in the July issue of *Gas Service*.

A dangerous shortage

THE Chairman of the West Midlands Gas Board, Mr. G. le B. Diamond, says there may be serious difficulties in gas production in the Birmingham and Black Country districts next winter. This will not be the result of a shortage in production plants but because of difficulties in obtaining men to run them.

Is there some fundamental cause for these difficulties in recruiting for the public utility, services? There seems to be a dislike of shift work, odd hours, or a combination of both. Clearly if the services are to be maintained and the agreed number of hours adhered to, some kind of alternating shift working or the staggering of hours is the only solution. An extensive pay rise would be no more than a palliative. The higher wages that might be offered are unlikely to exceed the total week's pay packet which the factory worker under easier conditions perhaps, could earn on piece work.

Are the youths of today who are going into industry becoming skilled artisans in greater numbers than hitherto? There does not seem to be much evidence for this. But there is much greater difference in status between those who do enter a skilled trade and those who do not. Here Mr. Diamond makes an interesting point. He complains that the training for a gas fitter is too thorough, and asks whether the written examination to comply with the City and Guild's standard is necessary.

Alderman Lewis, chairman of West Midlands Consultative Council seems to have got to the root of the matter when he suggested that gas board fitters were so well trained that the many tool rooms in the district merely snapped them up.

This does not explain the shortage of operators. Building sites, for instances, pay high wages and offer opportunities for overtime, so it may not be surprising that the secure jobs offered by the area boards cannot compete.

GAS ON THE CONTINENT

Cathodic protection for submarine pipe

IN 1959 the Copenhagen gas undertaking laid a 400-mm. h.p. gas pipe under the harbour between Amager and Sjaelland. This pipe is in an underwater tunnel which is normally flooded and which could only be de-watered for repairs at great expense. Also in the tunnel are several high voltage cables and a 650-mm. water pipe.

To avoid corrosion and graphitisation it was decided to provide the gas line with cathodic protection using zinc anodes. The reason for the choice of this method of cathodic protection was the risk of failure of the impressed voltage supply cables, etc., and the danger of parasitic currents promoting additional corrosion in other equipment in the tunnel. It would have been advisable to apply the impressed voltage to the other equipment, but the owners were not interested.

In the access shaft the gas line was flanged, otherwise rubber sealed couplings were used, so that electric connection between pipes was not assured. Hence each individual pipe had to be connected to a sacrificial anode. A small metal plate was welded to the end of each pipe and 1 m. of plastic-insulated 16-sq. mm. copper wire brazed to it. The welding and brazing was covered with Inertol paint.

A similar-sized continuity cable was laid along the length of the tunnel and brought up to a test point. The anodes were each 20 kg. of high-purity zinc. At each muff joint, *i.e.*, at about 12 m., a zinc anode was placed and the 1-m. lead from the anode, the lead from each pipe and the continuity cable were joined with a water-tight joint. Each pipe therefore has two connections to a different anode.

The continuity cable is not strictly necessary, but provides an added safeguard and enables a check to be kept on the consumption of the sacrificial anodes. At the same time it protects the gas line against parasitic currents. Having little experience of such cathodic schemes, the gas company's engineers were anxious to obtain the maximum information. Two test anodes were therefore provided, one in the shaft and one in the tunnel, each connected by an insulated cable to the test point. The anode in the shaft is normally left connected at the test point to the continuity cable and thus corrodes as the other anodes do.

When a test is desired, the difference in earth potential is measured for the shaft anode which has been corroding and the tunnel anode which has not provided any sacrificial corrosion. This gives a measure of consumption of the anodes.

Before assembly the pipework was given several coats of Inertol asphalt-base paint; nevertheless the cathodic scheme is based on a 10% bare surface. The life of the anodes is very difficult to calculate, but on the above basis should be 15 years. It is expected that the tunnel will be emptied every eight years. The scheme was engineered by Hans Arup, of the Metallurgy Laboratory of Denmark's Technical College.—*T. Madsen, Gasteknikeren,* Jan. 21, 1960, **49,** No. 8.

Sandstone strata used for storage

ONE of the great problems facing any gas industry, and for which there is no simple solution, is how to balance varying gas demands over different periods of the day, on week days and holidays and in summer and winter.

To a certain extent it is possible to balance these variations by suitable supply contracts and by careful control of gas production; it can also be done by altering the pressure in the grid supply system. But in practice it is best to take full advantage of gas storage, and high- and low-pressure gasholders have been installed to smooth out these variations.

As gas consumption has grown, so have the seasonal variations become more pronounced, and it has become necessary to find out how the growing consumption of gas during a cold winter can be met by putting it in store. To build large gasholders of conventional design is not feasible because their very high cost would cause a rise in gas prices.

In the U.S.A. it is possible to store gas in worked-out natural gas fields, but in Western Germany this was not possible since no such underground caverns existed. It was therefore necessary to find geological formations of a similar kind for gas storage.

German geologists have now found certain underground strata near Hanover, which, though not underground caverns, consist of sandstone rocks at a depth of 150 to 200 m. of a fine porous structure, and filled since remote antiquity with salt water. These strata are covered by a clay-stratum 100 m. thick, which is impervious to gas. A branch pipeline from the long-distance gas supply system of Ruhrgas A.G. was laid to this locality, and a compressor station was built over the storage area.

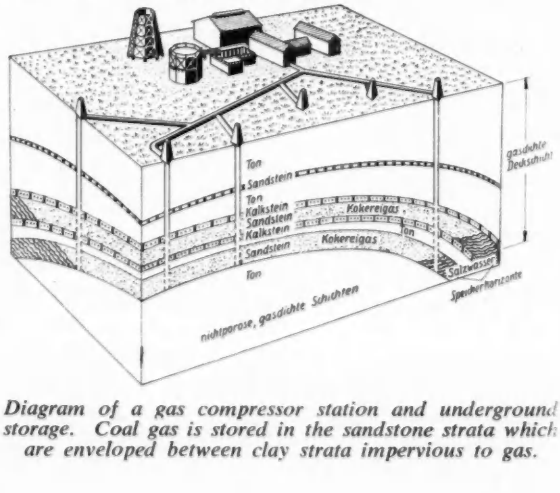

Diagram of a gas compressor station and underground storage. Coal gas is stored in the sandstone strata which are enveloped between clay strata impervious to gas.

During the summer gas from the Ruhr is compressed and stored in these sandstone strata; in winter the pressure is released and the gas re-enters the pipeline system.

This underground gas storage system is one of the first in Europe, and tests have been very successful. At the present time 155 mill. cu.m. of gas can be stored at Engelbostel, near Hanover. During the cold winter period of January, 1960, up to 800,000 cu.m. of gas were being taken daily out of storage. In this way the gas demands of the country around Hanover have been met.

Gaz de France research department report

IN its April issue the *Journal des Industries du Gaz* continues its report on the Gaz de France research department.

The Landy research station has been investigating the production of gas from the crude oils of Hassi-Messaoud (Sahara). Tests have been carried out on a large laboratory scale with cyclic reforming by steam, first using as catalyst the alumina (activaum S17) already used in the P2 process. The tests showed that at temperatures around 980°., it was possible to obtain gas directly interchangeable with town gas, although the presence of tar, naphthalene and sulphuretted hydrogen made the usual treatment necessary before distribution.

Tests were then aimed at the production of rich gas directly interchangeable with natural gas. The alumina, found unsatisfactory as a catalyst, was replaced by a less active 'masse de contact,' carborundum, which gave better results. At the same time total substitution for natural gas was not realised, even by the addition of products of combustion of the richest gases obtainable.

Attention was turned to the study of conditions permitting the production of gases containing roughly equal proportions of hydrogen and ethylene, which would enable the formation of ethane to be envisaged, at the expense of hydrogen, making the gases thus prepared totally interchangeable.

These considerations led to the birth of a two-phase process called P12:

1. Production by reforming in the presence of steam on a first catalyser of a gas characterised by a roughly equal content of ethylene and hydrogen.

2. Auto-hydrogenation of this gas at temperatures of 250°C. to 300°C. on an appropriate second catalyser.

Laboratory results are satisfactory but they have yet to be proved on the industrial scale. Success depends on a satisfactory maintenance of the catalyser in auto-hydrogenation.

This work will be discussed in a communication by MM. Salvadori, Lovy and Beigelman at the next congress of the Association Technique du Gaz.

Removing cyanide at injection trials

IT has been found necessary to remove cyanides to an even greater extent from gas injected into the underground storage at Beynes. Several purifying materials have been tried. The best results were obtained with a mixture, based on copper oxide, of bicarbonate of soda and wet wood shavings. About 50 mill. cu.m. (about 1,750 mill. cu.ft.) of gas were treated successfully by this process in the course of the last injection trials.

Tests of conversion and decarbonating are proceeding at Dinard on town gas produced by the continuous autothermic catalytic reforming of propane.

This treatment, applied at the outlet of the production vessel, consists in passing the gas, after addition of a convenient quantity of steam, over an iron catalyst at 400° to 450°C. to convert the CO to CO_2 with production of H_2, then, after cooling, compressing to about 6 atmospheres and washing with water to eliminate the majority of the CO_2. The process reduces CO content to 5% or 6% with a CO_2 residual of about 4% or 5%.

The experimental conditioning of gas in the distributing system at Creil since February 1958 with oil fog combined with humidification, has maintained leakage at the same level as before the change of gas. On the other hand sectors receiving gas with humidification and additional hydrocarbons deteriorated after showing satisfactory results for about a year.

Tests with oil fog have proved very satisfactory in a number of districts. It is concluded that oil fog combined with humidification can be used to counteract or even improve on losses by leakage in spite of changes in the characteristics of the gas distributed.

The use of N.A.M. (methyl naphthalene) in the vapour phase has been equally successful especially when combined with humidification. The progressive reduction in benzole content during the first months following a conversion of gas is not necessary when N.A.M. is used for conditioning. The use of K.S.O. (kérosène sans odeur) is also being tested. The influence of the hygrometric condition of the gas on the maintenance of pipework has also been studied.

The development of the transport of natural gas under high pressure called for a study of the problem of odorisation. In the selection of odorants, the research department has examined several commercial products, using highly developed modern methods of analysis and the Gaz de France odorimeter.

First results indicate that compounds of the mercaptan type are chemically much more active than those of the sulphide type, whether cyclic or non-cyclic. Methyl sulphide and thiophene could, in view of their odorant power, stability and price, be particularly interesting. Trials on an industrial scale will commence shortly.

More natural gas deposits discovered in U.S.S.R.

IN 1959, new natural gas deposits were discovered in the Bashkir district of the U.S.S.R., which contain certain reserves of 2.1 bill. cu.ft. of gas and probably up to five times more. Production will commence in 1960.

The additional gas supplies will allow the conversion of the Magnitogorsk metallurgical centre to gas and the Central Gas Board of the U.S.S.R. will complete in 1960 a 29-in. diameter, 60-mile pipeline from Kumertau to Ishimbaja where it joins the Shkapovo-Magnitogorsk pipeline.

The Shebelinsk gas deposits have been confirmed as being so large that a 41-in. diameter pipeline will be built to feed the gas into the Rostov (Don)-Lugansk grid. The 1960 programme includes the construction of three times more gas compressor stations than last year.

Serious difficulties are reported with the operation of the gas turbine sets on the Stavropol-Moscow pipeline and a number of new designs of gas turbines are to be given field tests. *Gazovaja Promyshlennost.* (Gas Industry). Vol. 5. No. 4. April, 1960.

GAS JOURNAL July 27, 1960

From a paper to the Northern Section of the I.G.E.

Modern trends in gas purification

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and

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WITH the intensification of competition in the fuel markets, both domestic and industrial, it is only natural that the gas industry should have concentrated most of its efforts recently on improved methods of gas production rather than on purification. Changes have resulted in the concentration of production units at fewer and larger works, generally of the orthodox type. The bulk of gas sold in this country is still manufactured in this way, and problems associated with the traditional methods of purification used are mainly due to an increase in the scale of operation as well as the need for the maximum possible efficiency. There is, also, however, the threat to established processes due to the change in markets for by-products because of foreign imports and synthetic processes operated in the chemical industry.

There has been an expansion in gas production from raw materials other than coal, which are based mainly on imported oil. The purification of the crude gas from some of these processes has called for modifications of existing techniques.

High pressure gasification by the Lurgi and Dent processes will call for special means of high pressure purification, so that full use can be made of the economic advantage of these pressures. This will be an entirely new field for the British gas industry.

Gas production methods apart, the growth of competition has stimulated the production of a better fuel, calling for new processes or the wider adoption of existing ones. These include the removal of sulphur compounds, and gum formers, and the elimination of toxicity by the reduction of carbon monoxide.

Costs of new processes

When any new process or modifications of an old one are contemplated, their cost must always be considered. With the present high price of gas, any such process which would add to that cost cannot be entertained unless the specific advantages obtained by using it will result in extra sales. This does not mean that processes should not be examined if they appear to be costly at the present time; industrial conditions rarely remain static and something which may not be accepted today may be commonplace tomorrow.

The removal of hydrogen sulphide by iron oxide[1] is still the most widely used method in this country, and so far has not been seriously challenged by liquid purification methods. There are, however, two specialised developments, the Gastechnik process which uses iron oxide in pellet form and the Appleby Frodingham process which uses a fluidised bed of iron ore at a high temperature[2].

Probably the most significant development in this field has been with the orthodox iron oxide process itself and is conveniently referred to as 'rapid rotation.' It represents a change in the method of operation rather than, as with most previous improvements, a change in plant design. The theoretical implications and actual operating results have already been described[3, 4]. The principle, which is known, is that of changing the order in which a series of oxide purifiers is operating, at much shorter time intervals than in orthodox practice. Swinging times of four hours and two hours, as opposed to the usual 24 hours or more, have been shown to offer considerable advantages. Briefly, by rapid rotation, temperature distribution and moisture retention are improved. As a consequence, higher gas loadings are possible, a higher sulphur content of the spent oxide is obtained and trouble caused by oxide hardening is diminished. Although large-scale work reported so far has involved the moving of valves by hand, automation is required if the swinging time is cut to four hours or less.

New Southampton installation

A new purifier installation has recently been commissioned at Southampton which may well set a pattern for the future, in that it was specifically designed for the rapid rotation technique. This plant, which was designed, built and commissioned in eight months, has a nominal capacity of 2.6 mill. cu.ft. per day of refinery gas at a pressure of 9 p.s.i.g. and containing up to 1,200 grains of hydrogen sulphide per 100 cu.ft. There are ten circular purifiers arranged to form a series of five 'takers,' each taker consisting of two purifiers in parallel. The valves on the installation may be divided into two groups:

1. Inlet, outlet and link main valves on each *taker*, i.e., each pair of purifiers, which are automatically operated by a Lockheed hydraulic system.

2. Inlet and outlet valves on each *purifier* which are hand operated when a purifier is isolated for emptying, so that the other of the pair takes 100% overload.

This arrangement enables rapid rotation to be carried out without interruption during oxide changing.

The plan has been in operation since December, 1959, on a sequence change, or rotation, every two hours. Air admission is geared to the automatic system and is admitted to the second taker. In this relatively short period there are not many results available, but no trouble has been experienced with the automatic valve system, beyond one or two valves sticking in the open position in the early days. Although the hydrogen sulphide content of the gas has varied considerably, purification has been satisfactory. There is no ammonia in the crude gas, so the correct neutral or slightly alkaline *p*H value is maintained by the addition of soda ash to the oxide.

Of liquid purification methods the 'Manchester' process might be mentioned, since experience gained on various plants has shown that there is no particular difficulty in purifying gas down to below Referee's standard or in ensuring continuity of operation. However, operating

costs are high and the crude sulphur produced is difficult to dispose of. Costs can be reduced appreciably if the ammonia normally present in the gas is used as the source of alkali instead of soda ash. This has a further advantage since the presence of sodium salts in the crude sulphur is not welcomed by acid manufacturers. The effect of the drop in world sulphur prices on the spent oxide market is well known and this has increased the difficulties in disposing of crude sulphur.

The most likely line of development would be a process which would produce a pure sulphur economically and preferably direct. Washing solutions rather than suspensions would have to be used and the line suggested by Davis, Mills and Ryder[5] of using an organic dyestuff as an oxygen carrier would seem the most promising.

Since nationalisation there has been an increased tendency for area boards to link their works together in the form of gas grids. This is a logical development and enables each board to make the best economic use of its carbonising plant.

Siting of new works

Base load works, with 100% load factors have been developed and where possible, new works are being sited to utilise suitable coal deposits or other sources of raw materials, such as oil, refinery gas or natural gas. Location of the works adjacent to any particular town is of secondary importance providing a suitable gas grid exists within the board area. Carried to its logical conclusion the idea of a 'backbone grid' appears to be ideal, by which gas produced economically at a few points in the system is distributed under pressure throughout the major industrial areas of the country. The use of high pressure distribution techniques enables main sizes to be significantly reduced and the mains themselves will also act to a certain degree as their own gas holders.

All welded mild steel mains may be used for high pressure distribution provided the gas is maintained at all times above its dew point. The main may then follow the contours of the land, without the need for regular syphons at low points, with a useful saving in construction cost.

The gas supplied to these mains must be sufficiently free from water vapour that even under winter conditions it is not cooled down to its dew point. Ground temperatures have been shown to vary from about 42°F. to 60°F. in the South West to 37°F. to 60°F. in Scotland[6], dependent on the time of year. Since main laying in this country is nearly all below ground except in exceptional circumstances, the ideal gas dehydration process should be capable of reducing the dew point of gas to be distributed in mild steel mains to below 37°F.

Calcium chloride has been the principal drying agent used in the British gas industry and up to now it has been the most economical process capable of giving the fairly modest degree of drying required. It is not capable, however, of giving dew points of the order of 37°F. throughout the year, since it is dependent on the contact temperature of the brine and gas. Investigation has shown that the gas could be dried with other saline solutions such as lithium chloride or lithium bromide, but the cost of the reagent would be at least ten times that of calcium chloride.

A mixture of magnesium chloride with calcium chloride has been considered but its performance is only very slightly better than calcium chloride alone. Glycols such as diethylene glycol or triethylene glycol, much favoured in America for drying natural gas, are unnecessarily efficient and expensive for our requirements, producing dew point depressions of 60°F. to 80°F. They also need specialised materials of construction to avoid corrosion, and added inhibitors to prevent their break down by oxidation or thermal decomposition. There is also a possible danger of reaction between the glycols and some constituents of coal gas, such as hydrogen cyanide.

As an alternative process, the gas may be chilled by normal refrigeration techniques to the required dew point. Refrigeration of gas is new in this country but has been used in Germany as part of a high pressure purification scheme[7]. A gas drying plant has been installed by the North Western Gas Board at Lostock Hall works, Preston, based on refrigeration, and has several unusual features. Primarily it was to dehydrate a high pressure gas stream to be carried in a mild steel welded gas main, but it was also designed to dry the local low pressure town gas supply.

Operating data and running costs for the process have been averaged for the month of February, 1960, and show a cost of .051d. per therm. There are two items which have not been included on the credit side of the operating costs. They are first, a reduction in syphon pumping and other distribution troubles associated with condensate in the gas mains, and secondly the effect of the lowered dew points on the Gas Examiners supplementary gas volume factors. We estimate that this latter represents a permissible reduction of 1 to 2 B.t.u. per cu.ft. in the calorific value of the make gas, but since the test was carried out saturated at 60°F., the calorimeter would still show the required declared value after correction.

An exhaustive survey of the occurrence of organic sulphur has been made[8], and was reported in 1947. The bad effects of organic sulphur in combustion appliances have been studied in detail[9, 10, 11]. Considerable use has been made of the oil washing process[12] but since this involves the simultaneous removal of benzole, it has only a limited application under present day conditions. Two catalytic processes have been developed to full scale[11, 13, 14] and many plants using one or other process are in operation in industry where a low-sulphur fuel is required for process work[15].

Holmes-Maxted process

In the Holmes-Maxted process, for instance, raw gas is heated first by heat exchange and then by an external source before it passes through the catalyst bed. Under suitable temperature conditions the organic sulphur is largely converted to hydrogen sulphide by reaction with some of the hydrogen normally present in the gas. At the same time the highly exothermic reaction between oxygen and some of the hydrogen is promoted by the catalyst, and represents a third stage of heating. Because of this latter reaction, the temperature through the bed depth is not uniform.

It is therefore difficult to define 'the temperature of the catalyst.' The highest temperature achieved, *i.e.*, when all the oxygen has reacted, is one way. Laboratory experiments carried out at Cleckheaton on c.v.r. gas, have shown (Fig 1) that this varies (*a*) in magnitude with the oxygen content of the gas and (*b*) in location in the bed depth with the gas rate; the effect of higher gas velocities is to push the point of maximum temperature further away from the gas inlet.

Catalyst activity varies with temperature. With nickel thiomolybdate mounted on granular activated alumina, there is little to be gained by using temperatures above 360°C, since conversion appears to be at a maximum at this temperature and below it the efficiency falls off. The temperatures given in Fig. 2 are the *maximum* temperatures in a 60-c.c. catalyst bed. Raising or lowering the temperature caused a slight temporary increase or decrease of organic sulphur in the treated gas, which was

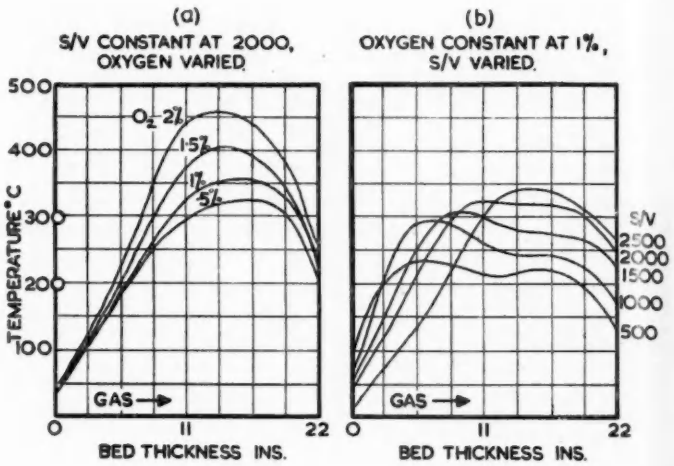

Fig. 1. Effect of (a) varying oxygen (b) varying space velocity on temperature distribution in catalyst.

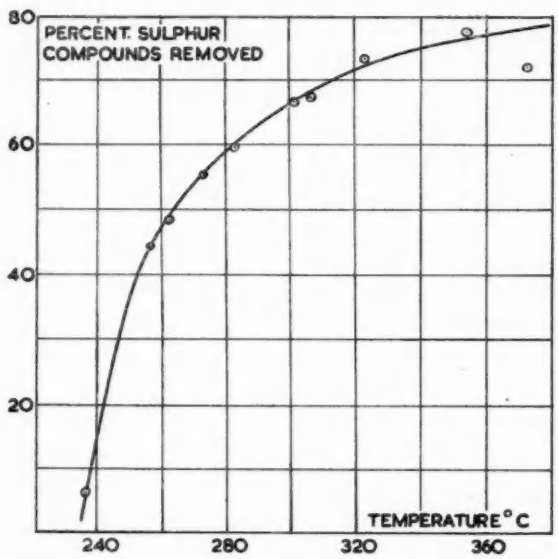

Fig. 2. Removal of sulphur compounds by Holmes-Maxted catalyst (Cleckheaton c.v.r. gas).

attributed to a temporary desorption or adsorption of sulphur by the catalyst itself and continues until a fresh equilibrium was established.

The influence of catalyst temperature ' on the degree of organic sulphur conversion is of considerable importance when considering full scale plant operation. The greatest possible reduction in sulphur content has to be balanced against the cost of operation at a higher temperature, since more fuel is needed not only to reach the higher temperature but also to counteract the extra radiation losses. Fuel is supplied in two ways: (a) As the hydrogen in the gas which unites with oxygen actually in the catalyst bed, and (b) as external fuel gas supplied to the gas heater following the heat exchangers.

Recent results have been collected from the full scale plant at the works of the Jersey Gaslight Co. Ltd., originally described by Wedgwood[11]. This plant operated on a steamed c.v.r. gas of low and reasonably constant oxygen content—with a declared c.v. of 480 B.t.u. per cu.ft.—and during the tests, the temperature of the catalyst bed was varied by adjustment of the volume of fuel gas to the heater. This temperature, as given in the results, was that of the gas after it had traversed the first pass of the annular shaped bed and represents the half way point of travel through the total bed thickness.

If the oxygen content is regarded as reasonably constant, together with the proportion of heat recovered in

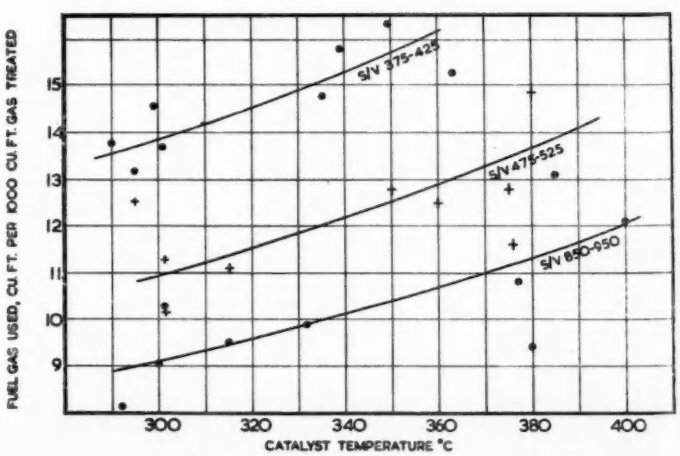

Fig. 3. Jersey c.s.r. Plant. Effect of s/v and operating temperature on Fuel Gas consumption.

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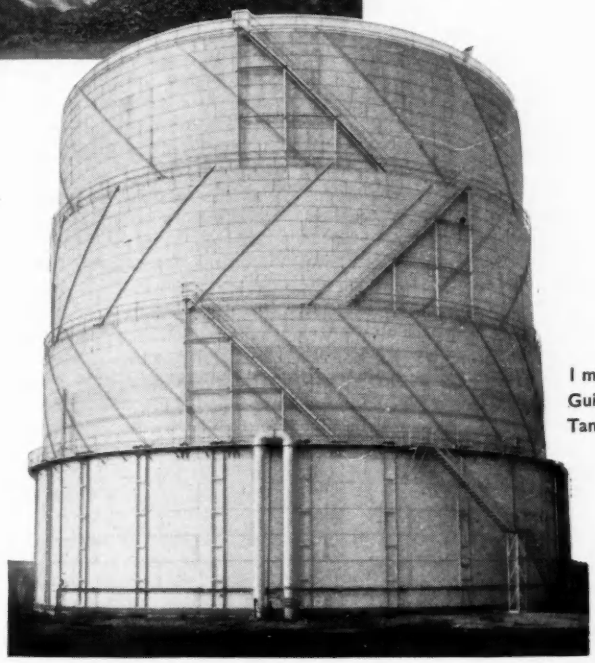

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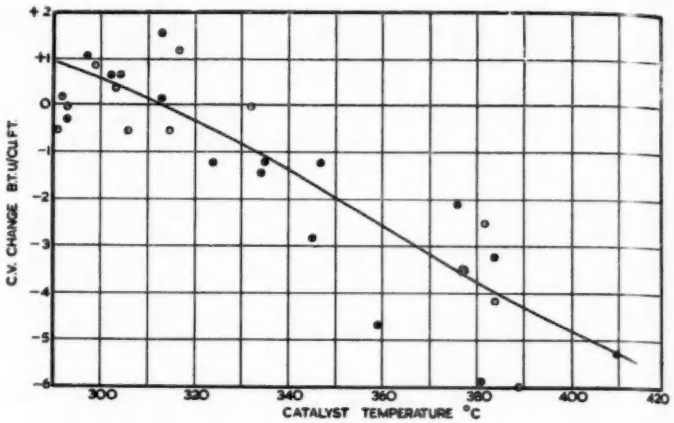

Fig. 4. Jersey c.s.r. Plant. Effect of temperature on change in c.v. of gas. Space velocity equal to 400-500, and 800-1,000, respectively.

the exchangers, the variations in fuel gas consumed give a rough practical measure of the heat economy of the plant. Observations show (Fig. 3) that the consumption of fuel gas per 1,000 cu.ft. of gas treated rises with operating temperature. Of much more marked significance are the changes due to gas throughput, calculated as space velocity in volumes of cold gas per volume of catalyst. The designed figure for this plant was 1,000 and the effect of running at lower loads shows a large increase in fuel gas consumption.

Sulphur content constant

The sulphur content of the inlet gas was fairly constant, ranging between 27.2 and 34.4 grains per 1,000 cu.ft. In the percentage removal of organic sulphur, the plant figures show a better performance than was found in the laboratory, particularly at the lower temperatures around 280 to 300°C. This may be partly attributable to differences in the 'temperature of the catalyst' but also partly because the full scale and laboratory tests were carried out on a different works, although the type of gas-making plant was the same. The difference of about 6% in the 340 to 400°C. temperature zone may be due to basic differences in the two gases, while the divergence at lower temperatures may be due to differences in temperature measurement.

A study of the plant of changes in the calorific value of the gas during catalytic treatment, which were obtained by calculating averages of several rapid successive determinations of the calorific value with a Sigma hand calorimeter, in general showed a gain at the lower and a loss at higher catalyst temperatures; the transition was at a recorded catalyst temperature of about 310°C. The gain in calorific value at lower temperatures is due to the oxygen reacting with some of the hydrogen, and causing a reduction in volume equivalent to that of the oxygen, while the gas is under heated conditions in the plant. On cooling, the water formed is condensed out to give a total volume reduction equal to that of both the reacted gases. If for instance a gas at 475 B.t.u. per cu.ft. contains .5% oxygen the gross calorific value after reaction would be 479 B.t.u. per cu.ft. due to a volume reduction of 1.0% hydrogen and .5% oxygen, a total of 1.5%.

There is a second reaction which occurs in which four of the gases begin to readjust themselves in accordance with the so-called water-gas equilibrium.

$$CO + H_2O \rightleftharpoons CO_2 + H_2.$$

Although there is no volume change when the gases are at reaction temperature, any water vapour in excess of that required to saturate the gas after cooling to atmospheric temperature is condensed out, but the net effect is a gain in gas volume due to the formation of carbon dioxide. Since the gross calorific values of carbon monoxide and hydrogen are nearly the same—318 and 320 B.t.u. per cu.ft. respectively—there is a net lowering of the calorific value. The equilibrium constant is such that carbon dioxide and hydrogen predominate at lower temperatures, the equilibrium moving to the left as the temperature is raised. The higher the temperature, the higher will be the carbon dioxide content of the treated gas with a lowering of its calorific value (Fig. 4). At first sight this might contradict what has been said about the effect of temperature, but does not really do so. As the temperature is raised the reaction velocity is increased and an approach nearer to equilibrium is achieved. At the lower temperature the velocity is far too low for this to occur.

In the whole range of catalyst temperatures from 293°C. to 423°C., gas analyses showed an increase in the carbon dioxide content of the gas together with a corresponding decrease in the water vapour content.. Theoretically, according to the water gas shift equation the disappearance of a given volume of water vapour should be accompanied by the appearance of an identical volume of carbon dioxide. In the results obtained it will be noted that this is approximately the case, variations being possibly due to errors in analysis and in the time gap between tests during which there were changes in gas rate and quality.

Two sources of water vapour

The two sources of water vapour for participation in the reaction were (a) that normally present in the ingoing gas, and (b) that produced by the hydrogen/oxygen reaction, both of which were added together for the purpose of calculation. The results show the following:

1. In the temperature range studied—293 to 423°C.—the water gas shift is proportionally greater the higher the catalyst temperature.
2. The shift is greater at the lower space velocities (500 volumes per hour) than at higher (900 volumes per hour).
3. In no case did the system CO, H_2O, CO_2, H_2 reach equilibrium.

The results and data show that, provided the slightly higher organic sulphur content in the treated gas can be tolerated, a given plant may be run more economically at a lower catalyst temperature of 300 to 310° than at 360 to 370°C., the lowest temperature at which maximum conversion is obtained. An additional advantage is that no measurable change occurs in the calorific value when operating at the lower temperature. A given plant should furthermore be operated as far as possible at the designed

throughput, otherwise the cost of fuel per unit volume of gas treated increases because of radiation losses.

Although the rate of carbon formation was not studied, past experience with the Mirfield C.S.R. plant suggests that it will be less at 300 to 360°C. than at 360 to 370°C., which will give a longer catalyst life between regenerations.

While there is as yet no direct correlation between the number of fatalities caused by inhaling coal gas and the carbon monoxide content of the gas[16, 17], the Gas Council has recommended that the carbon monoxide content of distributed gas should be less than 10%, though many people feel that a figure of 5% represents the target to be aimed at. It is, however, possible to detoxify the gas to concentrations of carbon monoxide well below 5%, but this concentration represents a reasonable figure to work to.

Various suggestions have been made[17] as to the method to adopt to bring about the maximum detoxification for the minimum effort. Such intermediate stages are really false economies and the gas industry should aim at distributing gas containing less than 5% carbon monoxide. If this is done, it will find that it can also claim that its distributed gas contains no more than 5 grains per 100 cu.ft. of organic sulphur. Detoxification of water gas alone, would only bring with it a proportionate net reduction of carbon monoxide in the distributed gas and similarly the organic sulphur burden would not be reduced to the desired limit for use in flueless heaters.

It is significant that all the plants so far installed[18, 19] treat the entire works output rather than only that fraction of the gas rich in carbon monoxide.

The water shift reaction is now well known. It has been used for over 70 years and a wide range of catalysts have been employed with some success. Problems do arise, however, in the gas industry, due to the presence of unsaturated hydrocarbons, gum formers and other polymerisable materials which tend to shorten the life of the catalyst by cloaking its active surfaces. Various forms of iron oxide promoted by chromium oxide are generally acknowledged to be very satisfactory for the shift reaction, but our interest in the removal of carbon monoxide from gas was first concerned with the possibility of using the Holmes-Maxted hydrogenating catalyst for this purpose. This catalyst is essentially an organic sulphur removal catalyst, but Wedgwood[11] reported that at Jersey, by feeding steam into the inlet organic sulphur removal plant, he obtained a significant degree of detoxification. Tests were undertaken in the laboratory in an all glass apparatus to check the degree of detoxification obtainable over the Holmes-Maxted catalyst. A high steam to gas ratio of 3:1 was used, since it was felt that the equilibrium would otherwise favour the formation of carbon monoxide rather than carbon dioxide. The space velocity used of 1,000 was the normal one for the hydrogenating reaction.

TABLE 1.

Temperature, °C.	Carbon monoxide conversion, %
250	31.0
250	28.2
350	29.7
400	29.5
450	37.4
500	66.0

The results shown in Table 1 tended to confirm that a portion of the detoxification obtained at Jersey could be attributed to the metal work of the heat exchangers, gas heaters, catalyst vessel and basket.

Based on a B.I.O.S. report[18] describing the detoxification plant at Hameln, pellets of Lux activated with potassium carbonate, were used as a water gas shift catalyst and the results are shown in Table 2.

TABLE 2.

Temperature °C.	Space velocity	Carbon monoxide conversion %
390	1,000	31.5
380	500	39.0
400	250	76.0

They confirm those quoted in the B.I.O.S. report where satisfactory conversion of carbon monoxide in excess of 90% was obtained with a space velocity of 140.

Proprietary water gas shift catalysts are made by several of major catalyst manufacturing firms, and tests were undertaken on three of these pelletted materials in order to find a shift catalyst capable of giving us the desired carbon monoxide outlet concentration preferably in one pass. Test runs carried out over a period of one month are summarised in Table 3.

TABLE 3.

Catalyst	Temperature °C.	Space velocity	Carbon monoxide conversion %
1	380	2,000	31
1	385	1,000	40
2	380	2,000	56
2	420	1,000	70
3	375	2,000	36
3	380	1,000	29

Steam to gas ratios here were of the order 1:3 to 1:5. It was important to keep the steam usage down to a reasonable figure if possible, since the cost of supplying steam to the detoxification process is the major single charge on the process. Based on the results obtained, catalyst No. 2 looked the most likely one for further development and accordingly further test runs were undertaken with it to define as closely as possible the optimum working conditions. Certainly variables were fixed to simplify this work, namely steam to gas ratio at 1:2, and a catalyst bed temperature of 375°C.

Protection of shift catalyst

In order to protect the shift catalyst, it was decided to precede it by a preliminary bed of Holmes-Maxted catalyst working at an operating temperature of 350 to 375°C. This was a precautionary measure, based on experience in the literature and not because of any trouble encountered in the preliminary test runs. Three comparative test runs were undertaken with and without the protective catalyst to discover the influence of space velocity on the reaction. Test runs exceeded two months without any fall off in conversion efficiency. Results with the unprotected catalysts were similar but gave slightly inferior conversion. Average results for the three protected catalyst runs using catalyst No. 2 are summarised in Table 4.

TABLE 4.

Space velocity	Approach to equilibrium %	Carbon monoxide conversion %
1,000	44.4	38.5
400	71.9	63.5
100	96.8	83.5

The concept of percentage approach to equilibrium was introduced to define more satisfactorily the performance of the catalyst. It can be defined as the actual carbon monoxide conversion obtained, expressed as a percentage of the theoretical carbon monoxide conversion attainable

at equilibrium at that temperature, with the known concentrations of carbon monoxide, carbon dioxide, steam and hydrogen in the feed gas mixture. Close approach to 100% means that the carbon monoxide conversion has attained the maximum possible under the stated conditions. Further conversion can only be attained by adjustment of the steam to gas ratio or passage of the gas through a second catalyst bed at a lower temperature. In our case approach to 100% means an outlet gas containing about 1% carbon monoxide and a 70% approach to equilibrium means an outlet gas containing about 3 to 4% carbon monoxide. For our fixed operating temperature and steam addition, we can therefore define the space velocity required for a given carbon monoxide conversion.

Work with the shift catalyst is still proceeding. The catalyst life is not yet defined, but it is expected to be at least one year. Other catalysts are being considered and they may prove to be more active and possibly less expensive, than the current pelletted materials.

Little has been said so far about the removal of organic sulphur which accompanies the water gas shift reaction. It has been referred to as a bonus which must appear on the credit side of the process cost. The removal of the organic sulphur as a process on its own, has been shown to cost and be worth about ¾d. per therm[11]. It is equally important and valuable to the consumer since the provision of non-poisonous gas and any process which can detoxify coal gas must have the removal of organic sulphur entered very positively on the credit side. Typical results for organic sulphur removal over protected shift catalyst No. 2 are summarised in Table 5.

TABLE 5.

Constituent	Removal %
Carbon disulphide	95
Carbon oxysulphide	90
Thiophen	20

The average organic sulphur content of the feed gas was 27.5 grains per 100 cu.ft.; the average organic sulphur content of the treated gas was 5.4 grains per 100 cu.ft., which gave an average overall removal of 80%.

Conversions of this order are attained equally when the shift catalyst is not preceded with a protective catalyst. Similarly the organic sulphur conversion appears to be independent of space velocity up to a value of 1,000. Conversion of the individual compounds agrees very closely with that obtainable over the conventional catalysts[13, 14].

Calorific value reduced

After detoxification, the calorific value of the gas is reduced[17], due to the formation of carbon dioxide, which remains in the gas as an inert diluent. Removal of the carbon dioxide by various extractive processes could restore the gas to its initial gross calorific value, since the hydrogen which is formed when the carbon monoxide is converted, very nearly possesses the same gross calorific value as carbon monoxide. Restoration of the calorific value by this means has two major disadvantages, first the various extractive processes are all expensive to employ and secondly after carbon dioxide removal, the specific gravity of the gas is significantly reduced and the hydrogen content of the gas is significantly increased. The Wobbe index of the treated gas may therefore vary markedly from that of the original and the flame speed of the treated gas may have increased so much that lighting back on aerated appliances becomes a nuisance. Coupled with this is a risk, that as the flame speed of the increases, the violence of exploding mixtures of gas and air may well become a source of alarm, and a possible danger to the consumer.

The possibility of restoring the calorific value and flame characteristics of detoxified gas by cold enrichment with butane has been considered and a very wide range of gases have been found to do this satisfactorily, thereby considerably reducing the complete cost of detoxification. Much work has been undertaken on the interchangeability of fuel gases and we have compared the methods of Weaver[20], Delbourg[21] and Gilbert and Prigg[22], who have all derived indices for predicting gas interchangeability. The methods of Weaver and Delbourg have only been used to act as cross checks on the method of Gilbert and Prigg, since Gilbert and Prigg's method is the only one directly applicable to our system of gas grouping. Using the analyses for typical group gases originally obtained by Wood[23] and Mills and Prigg[24], a series of calculations has been undertaken to see what change in combustion characteristics occur on detoxifying these gases to less than 5% carbon monoxide content and restoring the calorific value by cold enrichment with butane. The information obtained is very significant in that in each case complete interchangeability is suggested by Gilbert and Prigg and also by Weaver.

Other gases can be detoxified

The calculations suggest that a wide range of other gases can be detoxified and after cold enrichment with butane, possess essentially the same combustion characteristics as previously.

Cold enrichment by butane or similar l.p. gases is of interest worthy of consideration, but significant quantities of butane would be required if cold enrichment were practised on a large scale. A works making 10 mill. cu.ft. per day of group 7 gas would require 14.5 tons of butane per day for enrichment; requirements would in fact be directly proportional to the carbon monoxide converted in the gas. Horner, Jarvis and Turner[25] suggest that sufficient supplies of butane should be available in the United Kingdom to meet the requirements of the gas industry in the foreseeable future. Its price would depend on the quantity needed and the duration of the contract, but under the conditions of a suitably long term contract, it might well be obtained at a price comparable with or even cheaper than manufactured gas into holder.

If therefore the butane therm could be obtained for less than the price of gas into holder, there would be a useful saving in the cost of the process. Table 6 shows the expected costs for the combined detoxification and desulphurisation process and indicates the influence of the cost of butane on the final cost of the process.

TABLE 6

Butane cost, d. per therm	Complete cost of detoxification and desulphurisation d. per therm			
	G4	G5	G6	G7
13.5	1.51	1.62	1.74	1.86
10.0	1.10	1.16	1.29	1.30
9.0	.98	1.04	1.15	1.14
8.0	.87	.91	1.01	.97

The possibility of cold enriching detoxified gas, with methane or natural gas, brought to this country in ships like the Methane Pioneer has been investigated. Figures show that only for group 7 gases is it doubtful whether a satisfactory interchange with the enrichment gas would be possible. Interchangeability was only doubtful because the initial gas does not appear to have been a very good ex-

ample of a group 7 gas, though shown graphically on Gilbert and Prigg's curves a reasonable interchange would be possible in each case except for the group 7 gas. Owing to the relatively low calorific value of methane larger additions would be required than was the case with butane. McMullen[26] has published estimated costs for the delivery of methane from various oil fields to the North Sea area. An average of these costs suggests that methane could be delivered to our ports for 4½d. per therm. Specialised storage and handling facilities would be necessary, but even so it seems probable that the natural gas therm would be the cheapest available for enrichment. By these means the cost of detoxification and desulphurisation could probably be brought well below the figures quoted and a figure of .5d. per therm would not be impossible.

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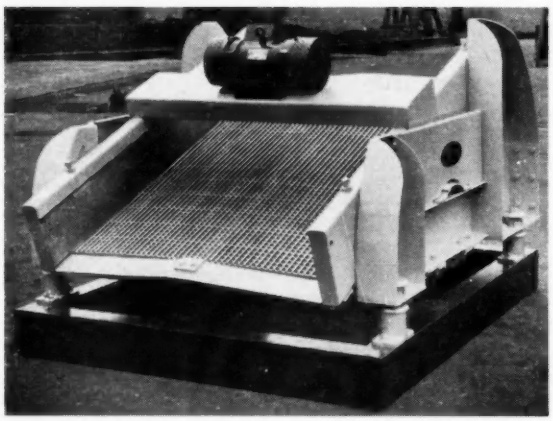
Technical developments

Screen drive

A NEW development in high speed vibratory screen design by W. J. Jenkins & Co. Ltd. includes a completely new driving unit.

On these screens, to be known as the Viking-Grantham, the drive and vibrator are incorporated into the motor, rendering obsolete the conventional out-of-balance shaft



with heavy bearings and 'V' rope drive. In addition to simplifying the design there is a considerable saving in the power required, and a wide range of adjustment to the amplitude of vibration is easily obtained. An adjustable angle of deck from 5° to 30° makes these screens suitable for a wide range of materials and duty.

Available as single and double deck models, the Viking-Grantham Minor has a tray 4 ft. long by 2 ft. 7 in. wide and the Viking-Grantham Major a tray 5 ft. long by 3 ft. 7 in. wide.—*W. J. Jenkins & Co. Ltd.*

Transistorised suppressor

THE suppressor, a small plug-in electronic assembly for use with the George Kent range of electronic instruments when applied to the measurement of a.c. signals, eliminates the possibility of amplifier saturation and errors in measurement, caused by the presence of a quadrature component in the input signal. The use of transistors, thermistors and other solid-state components only, ensure reliability and robustness.

The new unit effectively combats the quadrature effects that frequently occur in a.c. servo systems by applying an automatic cancelling action to any incoming quadrature components, whether stable in magnitude or not, while in no way interfering with the main input signal. The residual quadrature error signal, derived from the servo amplifier, is amplified and demodulated by a circuit containing four low-power germanium transistors and used to control differentially the power supplied to the heaters of two indirectly-heated thermistors. The circuit is direct-coupled from end to end and a third thermistor provides over-all negative d.c. feedback from the output to the input.

Designed for an electrical supply of 210-230-250 V. and 40 to 60 c/s., the suppressor works on an input of 0 to 10 V.r.m.s., with an input impedance of 1 megohm (resistive). It works with an output of 0 to ±1 V.r.m.s. at 90° to supply ±1°, with an impedance of some 700 ohms (resistive), at a maximum ambient temperature of 60°C.—*George Kent Ltd.*

New wire-braided hose

WINGFLEX high pressure wire-braided hose is made in one- or two-braid constructions for use with machine and pneumatic tools, earth-moving equipment, compressed air units and similar industrial applications. Supplied in bore sizes ranging from ½ in. to 2 in. with either re-usable or swaged couplings, and consisting of a seamless, oil-resistant synthetic rubber tube with a smooth bore, Wingflex hose is designed to operate under pressures varying from 600 to 4,000 p.s.i. in the one-wire braid construction and from 1,000 to 5,000 p.s.i. in the two-wire braid construction. Reinforced with high tensile steel wire uniformly braided over the lining with a cover of synthetic rubber compound, the complete hose is uniformly vulcanised and concentric throughout its length.

Supplied in either 60-ft. lengths uncoupled or in lengths coupled together, every single assembly is tested individually. Couplings are designed to withstand pressures well in excess of the burst pressure of the hose.—*Goodyear Tyre & Rubber Co. (Great Britain) Ltd.*

Portable conveyor

THE Numec Cadet, a portable conveyor with 2-in. corrugated sides as part of its belting, has an overall length of 22 ft. and can be operated at any angle up to 45°. It will load up to a height of 17 ft. with one end

on the ground, and its central height can be varied from 3 ft. 3 in. to 8 ft. 6 in. An electric-motorised drum can be fitted as an alternative to external drive by petrol or electric motor.

Depending upon the type of material and the operating angle, the Cadet has a capacity of up to 75 tons an hour. With its raised sides and cross bars, the belt allows a greater working angle than with normal belting, and makes possible an increase in the bulk carrying capacity by up to 50% over conventional belting of equal width.—*Numec Ltd.*

First O.T. boiler

THE boiler formally inaugurated in June 1960 at the Margam B power station of the Steel Company of Wales Ltd. is the first O.T. (Once-Through) forced-circulation boiler to be built on a commercial scale in Great Britain.

Often called a Benson-type boiler after its British inventor it is a water-tube forced-circulation boiler in which the feed water is heated, evaporated and superheated in a single passage through a number of tubes in parallel. For generating steam at high pressures, whether above or below the 'critical pressure' of approximately 3,200 p.s.i.g., it has many advantages over boilers using natural or assisted circulation, and the higher the steam pressure the more pronounced are the advantages.

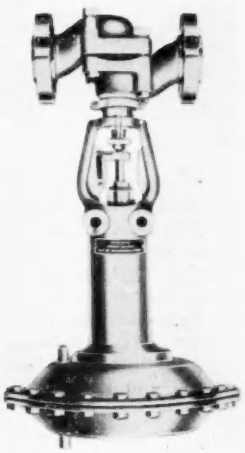
Based on the principle that water at the critical pressure needs no latent heat for conversion into steam and that therefore all the water flashes into steam when the necessary temperature is reached, the design requires no steam-release surface and no drums. It was found that O.T. drumless boilers also had advantages for steam generation at sub-critical pressures, and so boilers of this type are now in operation for steam generation at all pressure levels.

In the modern OT boiler, both for super-critical and sub-critical pressures, the heating surfaces consist throughout of small-bore tubes, and are so proportioned that up to 85% of the feed water is evaporated in tubes forming a 'radiant evaporative section' in the hottest zone of the combustion chamber.

The Margam O.T. boiler forms part of a 'topping' installation to supply the steelworks with additional process steam and electric power, using either blast furnace gas at a gross calorific value of 92 B.t.u. per cu.ft. fuel oil at a gross calorific value of 18,000 B.t.u. per lb.; the full output of the boiler is possible when burning either of these fuels or a mixture of both.

Steam generation at 3,300 p.s.i.g. and 1060°F. is the highest yet commercially used in Great Britain, and the extra-high pressure and temperature of the initial steam supply enable process steam to be exhausted into the existing 600 p.s.i.g. steelworks steam main from a back-pressure turbine, which drives a generator producing 9,500 kW of electric power.—*Simon-Carves Ltd.*

New diaphragm valve



THE Model 1550 split body single seated diaphragm valve, developed by the Audco Annin Division of the Audley Engineering Co. Ltd. at the request of instrument engineers in a wide variety of industries, is intended to supplement the range of Audco Annin Domotor valves for the simpler applications which do not justify the use of a positioner.

Retaining all the advantages of the split body construction used with the Domotor operated valves, its body and actuator sub-assemblies are interchangeable, making it possible to mount a positioner on its top or side if desired. Produced in a variety of metals including cast iron, stainless steel and bronze, the 1550 is now available in sizes up to 1-in., but shortly sizes up to 2-in. will be in production.—*Audley Engineering Co. Ltd.*

GAS JOURNAL

Readers' Enquiry Service

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Technical publications

K. S. Paul (Molybdenum Disulphide) Ltd. in their publication, 'Molybdenum Disulphide in Action,' outline some of the technical points connected with molybdenum disulphide as an aid to lubrication. By far the greatest part, however, is taken up by extracts from reports on specific cases in which this substance has enabled machinery either to function more efficiently or when seized up because of inefficient lubrication, to be started up again with little delay on applying molybden disulphide lubricants. Such machinery has then been able to run for extended periods without further trouble. These reports are divided into 11 sections, each of which deals with some particular aspect of lubrication. Included also are some short extracts from some scientific papers and a table of references.

* * *

'Process Plant for the Chemical Industry' published by Chemical Engineering Wiltons Ltd., briefly describes the tar products which can be obtained in a high state of purity by the use of Wilton plants.

Illustrated by photographs of installations at a number of tar product works, it has a frontispiece in colour of the National Coal Board's carbonisation and chemical works at Avenue near Chesterfield. Other illustrations show sections of plant built for area boards, the co-operative tar distillers and abroad.

* * *

P. G. Engineering Ltd. have lately published a paper 'Recent production data and costs for hydrogen over a range of pressures and purities' by Mr. P. Vesey, based on a similar paper he presented in October, 1959, to the North East Branch of the Institute of Fuel. In recent years three additional high-purity steam-hydrocarbon reforming plants operating at low pressures and one high pressure partial oxidation unit have been installed in the United Kingdom and on the Continent. They are now in full operation. The paper reports on recent work on these plants.

Centrifugal pumps

THE Pegson-Sultan pump is a vertically-split, end suction, single stage, centrifugal pump, manufactured in sizes from 1½-in. to 12-in. suction branch diameter, the entire range comprising 42 pumps with capacities from 20 to 3,500 gal. per minute.

Basically, designed round six sets of constant hydraulic shapes, each set of which produces a uniform performance pattern, a 12-in. Pegson-Sultan pump for example, is a pure geometric enlargement of any other model in the same hydraulic group. By keeping the suction eye constant for all pumps of the same suction branch diameter the number of parts has been reduced and interchangeability increased. The horsepower range—from ¼ to 75 h.p.—is covered by five bearing housing groups and, within each group, all shafts, seals, bearings, caps, keys and H.D. bolt locations are common. Comparing the new Sultan range with a similar range of 42 pumps in which none of the major components is interchangeable, the latter would involve some 1,250 parts while the Pegson-Sultan range has only 254.

Other design points include a contemporary styled bearing housing in which the mounting flange is rigidly supported at both the top and bottom, the shaft is accurately machined and of generous proportions for all loading conditions, and a choice of four interchangeable seals is available—three mechanical self-lubricating shaft seals and a conventional stuffing box with gland packing. Standard pump construction can be supplied in all iron, all bronze, iron with bronze trim and stainless steel.—*Pegson Ltd.*

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If you would like more information on products and services mentioned in the advertisement or editorial pages of the 'Gas Journal', fill in the coupons below, *one for each enquiry*, and send in unsealed envelope to **'Readers Enquiry Service', Gas Journal, 11, Bolt Court, Fleet Street, London, E.C.4.**

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WEST MIDLANDS GAS THREATENED BY PRODUCTION MEN SHORTAGE

BECAUSE of a shortage of production men, there is a threat of a breakdown in gas supplies in Birmingham and the Black Country next winter, Mr. G. le B. Diamond, Chairman of the West Midlands Gas Board, said last week. He told members of the area gas consultative council at a meeting in Birmingham that 200 extra production men were needed for peak demand output. 'I want to bring home to the public the seriousness of the position,' he said. 'We could have a breakdown in essential supplies.'

The 200 men were needed in the Board's central area, which included Birmingham and the Black Country, and were in addition to 100 gas fitters needed in the West Midlands.

'Where they are coming from, I just don't know,' Mr. Diamond said. 'The same goes for all kinds of things. We read of 300 buses being left in garages through shortage of crews, and we have been told that on the railways 100 footplatemen are needed.

MIRACLE NEEDED

'I suppose in some miraculous way we shall manage. It may be that the Government measures on the economic side will result in us getting these men. Meanwhile, we shall do everything we can to see that there is no breakdown.'

Earlier, Mr. Diamond had criticised the system of training gas fitters as contributing to the shortage in the West Midlands.

He thought the scheme laid down for a five-year apprenticeship and a written examination was wrong.

CRAFTSMEN WANTED

He suggested men should be trained vocationally, and the written examination omitted. They should have gas fitters who could carry out craft work and not sit down to pass a written examination.

Apprentices in the gas industry should be allowed to do more practical work and earn more money in training.

Alderman John Lewis, Chairman of

Continued on p. 143.

NEWS SUPPLEMENT

Well yes, we know how it feels!

THE Midland Electricity Board has complained to Halesowen Borough Council that council house tenants are not being given a choice of gas or electric cookers.

An M.E.B. spokesman said: 'The council is making up its tenants' mind for them. We think this is unfair. The M.E.B. wants a fair crack of the whip.

A corporation official explained that just before the war many houses were made all-electric, but today most houses were fitted with gas cookers.

Electric cookers could be installed at the tenant's own request.

GREATER SCOPE AT PIPELINES EXHIBITION

PREPARATIONS are now under way for the second international pipes and pipelines exhibition, which will open at Earls Court on April 9, 1962, probably with a greatly increased ground floor area.

Since pumps and valves are integral parts of the industry, they will be included in the exhibition which will be called the Second International Pipes, Pipelines, Pumps and Valves Exhibition and Convention. The scope of the second exhibition is, accordingly, considerably wider than the first, covering pipes, hose and tubes (rigid and flexible), pipeline equipment, fabricated pipework, pumps, valves, fittings, chemical plumbing, mainlaying, insulation, protection, testing, and all the necessary ancillary equipment and processes for the application of pipes, pipelines, pumps and valves in every industry.

Coupled with the exhibition, for which numerous space demands have already been received, a technical convention will be held at which the latest techniques in pipeline engineering, pipe and tube technology, and pump and valve design, will be discussed by leading experts.

Over 10,000 visitors attended the first exhibition, coming from many overseas countries as well as from all over Britain, and it is expected that considerably larger numbers will come to Earls Court in April, 1962.

Board places reforming unit order with W-D

WOODALL-DUCKHAM Construction Co. Ltd. announces that an order has been received from the North Western Gas Board for a single-unit MS reforming plant to be built at the Crewe gasworks.

The new plant, which will be automatic in operation, will gasify light distillate (p.f.d.) and have a guaranteed output of 2.2 mill. cu.ft. of 450 B.t.u. gas per day.

The installation will include a waste heat boiler and be self-supporting in steam, a water cooling and recirculating system and a standby diesel generator to provide an alternative source of electric power.

Constructional work is to commence shortly and the plant to be put into operation in the early autumn of 1961. This is the third W-D/MS reforming plant to be built in this country for the gasification of light distillate.

Irish peat exhibition opened in London

BORD NA MONA—The Irish Peat Board—has opened an exhibition at the Irish Exports Centre, Regent Street, London.

Opening the exhibition Mr. Erskine Childers, Eire Minister for Transport and Power, said that briquetted peat was a high grade and very attractive fuel. It was easy to handle, free from clinkers and of low bulk density.

Bord na Mona was currently building plant for a five-fold increase in its capacity for the production of peat briquettes.

'With this increase the home demand will be fully met and there will be, for the first time, a surplus for export. You will soon see this attractive product on the British market.'

Uses for peat, he pointed out, included gas production.

In January, 1958, a cargo of milled peat was shipped to the South Eastern Gas Board in London for tests in the manufacture of coke.

The problem facing the Gas Board was that the type of coal available to them did not produce coke of the high grade desired; after about a year of experiment the problem was solved to the satisfaction of the Gas Board by the addition of a relatively small amount of milled peat to each charge of coal going into the retorts.

Some 22,000 tons of peat were supplied for this purpose last year.

Mains disturbed in railway modernisation

POWER LINES BRING HAZARD PROBLEMS

GAS distribution engineers are making a vital contribution to British Railways London Midland Region electrification scheme for the main line between Liverpool, Manchester and London. Nearly 800 bridges have to be altered or completely rebuilt to accommodate the electrical equipment and many of them carry gas mains across the railway line.

PART OF GRID

One of the biggest bridge reconstruction schemes to date, in the Liverpool-Crewe section, is at Picton Road, Liverpool, where the whole bridge is being completely rebuilt to the most advanced standards at a cost of £165,000. Gas mains ran along each side of the bridge—a 24-in. by 12-in. rectangular high-pressure main serving an industrial estate and a 24-in. diameter main serving a large residential area at West Derby and Newsham Park. Both mains are part of the gas grid.

The Picton Road Bridge is more than 600 ft. long and crosses the main line out of Lime Street Station, Liverpool, and the complex network of sidings at Edge Hill marshalling yards, all of which will be served by overhead catenary and contact wires carrying 25,000 volts a.c. of electricity. Special safety precautions have to be taken to protect gas mains where they cannot be concealed in the bridge structure.

Both of the gas mains are to be carried across the railway at Picton Road on a special span to be built alongside the new railway bridge. The new mains are being fitted with a complex earth wiring installation so that in the event of mishap of any kind, or of any loose object falling or being thrown in such a way that it makes contact with the railway power lines, the current would run to earth before it could arc through the gas mains.

The work at Picton Road falls into three distinct phases: (1) Erection of temporary mains to carry the gas supply during the reconstruction scheme; (2) demolition of the old mains; and (3) construction of new mains.

CO-OPERATION PRAISED

During a Press inspection of the work last week, railway modernisation and electrical engineers paid tribute to the co-operation and assistance they had received from the distribution staff of the Mersey Group, North Western Gas Board, in planning and carrying out the work.

Gas mains cross the Liverpool-Crewe railway line at six other points in the Liverpool area alone and at each point the height and location has to be altered.

This picture shows the temporary 24-in. diameter main at Picton Road Bridge, Liverpool. Eventually two gas mains will be carried across the railway on a special span.

WELSH TARIFFS SHUFFLED; COMMERCE PAYS LESS, THE HOUSEWIFE MORE

WELSH gas is to cost more for the housewife and less for the larger commercial user. Tariff changes, affecting the whole of the Principality, have been announced by Mr. Mervyn Jones, Chairman of the Wales Gas Board.

The Wales Gas Consultative Council have unanimously accepted the Board's new price structure. The changes will come into effect immediately following the next meter reading.

Mr. Jones told the consultative council that the weekly increase for the average family would be 3d. For the smaller user on a single tariff scale there would be an increase of 2d. per therm.

There would be no increase in price for domestic consumers on the two-part tariff system although their standing charge would be increased by 3s. 3d. a quarter. The effect would be the same on both types of user.

Meter rents which at present varied between 1s. and 6s. 6d. would be standardised at 3s. 3d. a quarter.

Larger commercial users such as hotels, caterers and schools will pay ½d. less per therm than at present. This concession, said Mr. Jones, would match earlier reductions made to domestic and large industrial users and would also enable the Gas Board to compete favourably with the oil industry in space heating.

The effect of these changes was estimated additional revenue of £325,000 a year to offset wage awards and other costs amounting to £394,000.

The difference was expected to be made up by economies within the industry and a continuation of the trend for substantial increases in the number of consumers.

N.E. price held but service charges raised

THE North Eastern Gas Board, is not at present contemplating any price increase.

This was announced by Alderman H. Sutcliffe, Chairman of the area consultative council, which accepted the Board's proposal to increase the charges for installing and maintaining appliances.

Alderman Sutcliffe told the council the Gas Board had been losing £120,000 a year on installation work.

The higher scale of charges would recover about £70,000 a year, and the Board would still be losing £50,000.

Alderman Sutcliffe gave the Council a few instances of how the increased charges would operate. The cost of fitting a water heater would increase from £3 10s. to £6. That was probably one of the highest increases. The installation of a cooker would go up from 25s. to 30s.

Short weight

Of the 45,096 sacks and 107 loads of coal, coke and other fuel examined by the Leeds Corporation Weights and Measures Department in the year ended March 31 last, 500 sacks and three loads were found deficient.

PERSONAL NOTES

COUNCILLOR W. H. FOSTER has been appointed Deputy Chairman of the East Midlands Gas Consultative Council in succession to ALDERMAN MRS. R. HODSON. Councillor Foster, a colliery checkweighman, is a member of Nottingham County Council and chairman of the county planning committee and a member of several other committees. He is holder of the Colliery Deputy's Certificate.

MR. D. A. F. DONALD, Chairman and Managing Director of National Cash Register Co. Ltd., has been appointed Chairman of G. A. Harvey & Co. (London) Ltd. Sir Thomas Overy has resigned the chairmanship on medical advice, but remains a Director of the company.

MR. T. MERVYN JONES, Chairman of the Wales Gas Board, was married at Newport Tabernacle Congregational church last week to Miss Margaret Cashmore.

MR. W. H. ADAMS has been appointed General Manager of Head Wrightson Iron & Steel Works Engineering Ltd.

EXPLOSION STARTS FIRE AT GASWORKS

AN explosion in the booster room of the North Thames Gas Board's works at North Sheen on Sunday caused a serious fire and injured four men, two of whom are Mr. Spencer Wade, aged 49, of Alexandra Road, Richmond, and Mr. John Underhill, aged 58, of Clayponds Avenue, Brentford, Middlesex.

Mr. Underhill heard the explosion and ran into the booster room, where he saw Mr. Wade covered in flames. He dragged him clear of the burning room, being burned himself in doing so. Mr. Wade kept crying out: 'Turn off the main valve.'

The force of the explosion tore slates off the roofs of houses nearly 200 yards away. The fire was under control within 20 minutes of the arrival of fire appliances, but two hours later streets were still being cleared of debris and broken glass.

Mr. J. E. Davis, O.B.E., Chief Technical Officer, South Eastern Gas Board (left), receives a watch from Board Chairman, Mr. R. N. Bruce. Mr. Davis is one of 40 S.E.G.B. employees who has recently received long service awards.

Durham cokemen strike threat

THE Durham Panel of Cokemen's Lodges, an unofficial organisation, has recommended Durham's cokemen — between 1,500 and 2,000 of them—to give 21 days' notice of intended strike action over wages and conditions.

Mr. Frank Gibson, the Panel Secretary, said that the cokemen were dissatisfied with the rejection of their claim for a wage increase of 2s. 8d. a shift for men on continual shift work.

They had also been dissatisfied with the way the National Union of Mineworkers had handled the matter.

Mr. Gibson said that the present minimum wage for cokemen was £7 10s. after deductions with £9 10s. for top men.

A representative of the Northern Gas Board said that in view of the fact that there are 1.4 mill. tons of coke stocked in Durham at present, the strike would have little effect unless it was prolonged.

Every effort would be made to keep plants going by transferring other workers in order to maintain gas supplies.

Mr. T. W. Tindale of Barnsley, Secretary of the cokemen's section of the N.U.M., said that any action by the Durham Panel would be entirely unofficial.

West Midlands production threat—from p. 141

the consultative council, said: 'These fitters are known to have very good craft training. They are snapped up very rapidly by tool-rooms all round the Midlands where they get more money than we can pay.'

Alderman H. H. Coghlan (Stafford) suggested that the training system did not encourage good practical men to become gas fitters.

Mr. Diamond replied: 'There is a nationally agreed system for the whole country. It is acceptable in nine-tenths of the country because they do not have our problems. The rest of the country would not agree to alter the scheme for our convenience, and that is where we come unstuck.'

Mr. Diamond appealed to consumers to get in winter stocks of coke because of the shortage of labour.

Commenting on a remark that some industrialists were paying ½d. per therm more on the industrial tariff than domestic consumers on the new domestic two-part tariff, Mr. Diamond said that if they went on losing the domestic load, the industrial consumer would, in the end, have to pay more.

The new two-part tariff for domestic consumers had been well received by industrialists on the whole.

NEW STANDARDS—COMMITTEE SET BENZOLE TESTS

NEW standard specifications for benzole and allied products came into effect on July 1. The Standardisation of Tar Products Tests Committee has issued the following tests:

Polymerisable hydrocarbons in naphtha fractions ...	LB23-59
Crystallising-point of pure benzene	LB24-59
Corrosive sulphur—mercury test	LB25-59
Hydrogen sulphide ...	LB26-59

Resin manufacture

The first of these tests is a refinement of the McIlhiney tests, in which the sample is brominated at 0°C. with a solution of bromine in carbon tetrachloride, the excess of bromine being estimated idiometrically. The test is intended primarily for the evaluation of naphtha fractions for resin manufacture.

The new test for determining crystallising-point was required because of the increasing purity of the benzene now required for synthetic processes. As the purity now approaches 100%, it follows that the variations in purity, represented by the test variations of the older test, are a much greater proportion of the total impurity present.

Initial cooling

The present test controls the initial cooling of the sample, eliminates many of the errors due to radiation and uses a thermometer that can be read to 0.005°C. The repeatability of the test is 0.01°C. and the reproducibility 0.035°C.

The revised test for corrosive sulphur, in which the sample is reacted with mercury, the quantity of sulphide formed being determined by filtering it off under standard conditions and comparing the stain with standards, is quicker and more reproducible than the copper strip test.

Some samples, particularly xylenes, contain peroxides that also react with mercury, but these are eliminated immediately before reacting with mercury by adding a small quantity of a solution of hydroquinone.

More sensitive

Quantities of hydrogen sulphide that are less than the limits of sensitivity of both the new mercury test and the doctor test, are sufficient to cause corrosion of copper and some cupriferous alloys. A more sensitive test for hydrogen sulphide has, therefore, been introduced.

OBITUARY

MR. WALTER SLINGSBY, who was governing director and founder of Walter Slingsby Ltd., has died in his 87th year.

PUBLISHERS' NOTICE

The "Gas Journal" is published every Wednesday, price 1/6d.; by post 1/9d.

Subscription Rates: Home 65/–; Overseas 72/6 per annum; (Both payable in advance.) A copy of the "Gas Journal" Calendar & Directory is presented each year to continuous subscribers.

Classified Advertisements: All small classified advertisements are charged at 3/6 per line (approx. 7 words)—minimum charge 10/6. A Box Number address occupies 2 lines, and a further 6d. is charged towards cost of postage on replies. Copy must be received by first post on Monday to ensure insertion in that week's journal.

Displayed Advertisements: Rates obtainable on application to the Business Manager. Change of copy for displayed spaces must be received 14 days prior to publication if proofs are required. Type area of inside pages 10 in. deep x 7 in. wide; block screen 120.

BUSINESS MANAGER: S. T. CULLEN

NORTHERN MANAGER: Philip W. B. King, 11, Tewit Well Road, Harrogate. *Telephone:* Harrogate 69212.

SOUTHERN REPRESENTATIVE: R. F. Crocker, 11, Bolt Court, Fleet Street, London, E.C.4. *Telephone:* FLEet Street 2236-7

MIDLANDS REPRESENTATIVE: Gerald F. Harwood, 76, Broad Lane, Kings Heath, Birmingham, 14. *Telephone:* Highbury 4502.

WALTER KING, LTD., 11, Bolt Court, Fleet Street, London, E.C.4.

Telephone: FLEet Street 2236-7. *Telegrams:* Gasking, Fleet, London. 22—7/58

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APPOINTMENTS VACANT

CITY OF BELFAST

APPOINTMENT OF ENGINEER AND MANAGER, GAS DEPARTMENT

APPLICATIONS are invited from suitably qualified persons for the above position.

Candidates should be Corporate Members of the Institution of Gas Engineers or hold other acceptable qualifications; they must have wide experience and have held a responsible position in the Gas Industry, preferably in the administration and technical management of a large Gas Undertaking.

Candidates should preferably be under 50 years of age.

Salary scale—£3,150 × £135—£3,555 per annum.

Commencing salary determined having regard to qualifications and experience.

Superannuation contributions of approximately 6% of remuneration payable. Reciprocal pension arrangements exist between the Corporation and certain other Authorities including the Local Government Service in Great Britain.

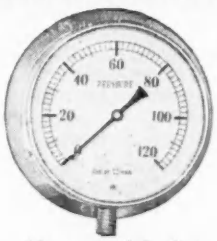
Application forms and conditions of appointment obtainable from the Establishment Officer, Room 18, City Hall, Belfast.

Completed applications must reach the undersigned by Thursday, August 18, 1960.

JOHN DUNLOP,
Town Clerk.

City Hall,
Belfast,
P.O. Box 234.

PRESSURE GAUGES



Please send for list
GREEN & BOULDING, LTD.
162a, DALSTON LANE, LONDON, E.8

WEST MIDLANDS GAS BOARD
WOLVERHAMPTON AND DISTRICT DIVISION

LECTURER—GASFITTING

A VACANCY has occurred on the Board's Staff for a full time lecturer in the theory and practice of Gasfitting and associated subjects at the Dudley and Staffordshire Technical College. All the Gasfitting apprentices in the Division, approximately 75 in number, attend at this College.

Candidates should preferably have previous experience in the teaching of Gasfitting.

The salary for the appointment, which is pensionable and subject to medical examination, will be within the range of £975-£1,095 per annum.

Living accommodation can be made available, if required.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to Mr. S. Jones, Divisional General Manager, West Midlands Gas Board, P.O. Box No. 34, Kensington House, Bath Street, Dudley, **to reach him not later than August 5, 1960.**

WEST MIDLANDS GAS BOARD
WARWICKSHIRE DIVISION

VACANCY FOR
ASSISTANT CHEMIST
HINCKLEY DISTRICT

CANDIDATES should possess the Higher National Certificate in Chemistry and have experience of the chemical control of plant.

The salary for the appointment, which is pensionable and subject to medical examination, will be within the range of £770-£870 per annum.

Applications, stating age, qualifications and experience, should be addressed to Mr. A. Allen, Divisional General Manager, West Midlands Gas Board, Gas Street, Coventry, **to reach him not later than August 8, 1960.**

NORTH WESTERN GAS BOARD
CENTRAL LANCASHIRE GROUP

DEPUTY STATION ENGINEER,
ROCHDALE PRODUCTION STATION

APPLICATIONS are invited for the above pensionable position at a salary within Grade A.P.T. 12 (£1,006 to £1,131 per annum).

Applicants should be experienced in the control of works, with vertical retorts and C.W.G. plant.

Detailed applications, giving the names of two referees, should reach the General Manager, Central Lancashire Group, North Western Gas Board, Stanley Buildings, Silver Street, Bury, within fourteen days.

INDUSTRIAL REPRESENTATIVE

APPLICATIONS are invited for the post of Industrial Representative in the Southampton Region. The starting salary will be within Grade APT. 7-9 (£733-£927) of the National Salary Scales for Gas Staffs, according to experience and qualifications.

Applicants must have had good experience of dealing with industrial and/or commercial enquiries, including space heating.

Successful candidate will be required to pass a medical examination and unless already subject to a Pension Scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required to join the Board's Staff Pension Scheme.

Forms of application may be obtained from the Personnel Manager, Southern Gas Board, 164, Above Bar, Southampton, to whom they should be returned by Wednesday, August 17, 1960.

KENT EDUCATION COMMITTEE
MEDWAY COLLEGE OF TECHNOLOGY
DEPARTMENT OF BUILDING

GRADE B ASSISTANT LECTURER IN GASFITTING

APPLICATIONS are invited for the post of Assistant Lecturer in Gasfitting and Supply subjects. The successful candidate will be expected to teach Gasfitting Theory and Practice to the final grade City and Guilds and possibly assist in teaching Gas Supply.

Applicants should have had a wide industrial and teaching experience and must hold the Full Technological Certificate in Gasfitting and preferably be Associate Members of the Institute of Gas Engineers.

Further particulars and application forms, which should be returned within 12 days of receipt, may be obtained from the Principal, Medway College of Technology, Horsted, Maidstone Road, Chatham, Kent. S.a.e.

Classified Advertisements

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